Remarks

I. Status of claims

Claims 1-20 are pending.

Claim 21 has been added.

Claims 1 and 15 are independent claims.

Claims 2-14 and 21 depend from independent claim 1 and claims 16-20 depend from independent claim 15.

II. Claim rejections

A. Claims 1-9 and 15-17

The Examiner has rejected claims 1-9 and 15-17 under 35 U.S.C. § 103(a) over White (U.S. 5,665,655) in view of Dias (U.S. 6,812,548).

1. Independent claim 1

Independent claim 1 recites:

> Claim 1 (original): An integrated circuit system, comprising:
>
> a die incorporating an integrated circuit and having a top side and a bottom side, the top side supporting an electrical signal communication metallization and a top side thermal dissipation metallization, and the bottom side supporting a bottom side thermal dissipation metallization.

In his rejection of independent claim 1, the Examiner has stated that FIG. 25 of White shows "an integrated circuit system, comprising: a die 1 incorporating an integrated circuit 2 and having a top side and a bottom side, the top side supporting an electrical signal metallization 6 and a top side thermal dissipation metallization 9 ... ." The Examiner's asserted correspondences between the elements of White's device and the elements of claim 1 are incorrect for the following reasons.

First, the substrate 1 disclosed in White does not constitute an integrated circuit system die. Rather, the integrated circuit system die disclosed in White corresponds to one of a plurality of regions that have been singulated from the processed substrate 1, each region of which consists of a composite structure that includes a respective portion of the substrate 1, the active region 2, and the overlying interconnect layers.

Second, the active region 2 does not constitute an integrated circuit. Rather, the integrated circuit disclosed in White consists of the active region 2 and the overlying interconnect layers. Indeed, there is no "circuit" without the interconnect layers.

Third, the electrical contact 6 (which the examiner has stated corresponds to the electrical signal communication metallization recited in claim 1) is not supported by a top side of the die disclosed in White. Indeed, the electrical contact 6 is buried under a number of overlying layers of the die.

Fourth, element 9 is not a top side thermal dissipation metallization, it is instead an electrical interconnect that is connected to the active region 2 by a tungsten contact 6 (see, e.g., FIG. 25, col. 5, line 63, and col. 10, line, 12). Indeed, one skilled in the art at the time the invention was made reasonably would have expected the buried electrical interconnect 9 to have dimensions that are not sufficient to produce any appreciable thermal dissipation in the integrated circuit system dice disclosed in White. In addition, the electrical interconnect 9 is buried; it is not supported by a top side of an integrated circuit system die. For these reasons, one skilled in the art at the time the invention was made would not have had any reasonable basis to consider the buried electrical interconnect 9 to be a top side thermal dissipation metallization that is supported by a top side of a die of an integrated circuit system, as recited in claim 1.

Dias does not make-up for the failure of White to teach or suggest a top side thermal dissipation metallization that is supported by a top side of a die of an integrated circuit system, as recited in claim 1. Dias discloses that the top side of the die corresponds to the topmost one of the interconnection layers 112 (see, e.g., FIG. 5). Dias does not specify whether the top interconnect layer is a dielectric material or a patterned electrically conductive material (see col. 4, lines 4-12). The top layer of an interconnect layer stack of the type disclosed in Dias, however, typically is a dielectric passivation layer (see, e.g., the passivation layer 48 shown in FIG. 25 of White). In addition, one skilled in the art at the time the invention was made reasonably would have expected the patterned electrical

interconnects disclosed in Dias to have dimensions that are not sufficient to produce any appreciable thermal dissipation in the integrated circuit system dice disclosed in Dias. For these reasons, one skilled in the art at the time the invention was made would not have had any reasonable basis to believe that Dias' die includes a top side thermal dissipation metallization that is supported by a top side of a die of an integrated circuit system, as recited in claim 1.

Thus, neither White nor Dias teaches or suggests an integrated circuit system that includes a top side thermal dissipation metallization that is supported by a top side of a die. Therefore, the combination of White and Dias cannot possibly teach or suggest the invention defined by independent claim 1. For at least these reasons, the Examiner's rejection of independent claim 1 under 35 U.S.C. § 103(a) over White in view of Dias should be withdrawn.

In addition, the Examiner has stated that "It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a bottom side thermal dissipation metallization layer in the back surface of the die disclosed in White to facilitate the attachment of a heat spreader to the back surface of the semiconductor device since most of the thermal interface materials do not wet (i.e., stick to) semiconductor wafers as taught by Dias." The Examiner, however, has failed to explain why one skill in the art at the time the invention was made would have been motivated to attach a heat spreader to the back side of White's die in the first place. Indeed, assuming for the purpose of argument only that the Examiner's factually incorrect assertion that the buried interconnect 9 in White's die functions as a top side thermal dissipation metallization, what would have motivated one skilled in the art at the time the invention was made to attach a second thermal dissipation metallization to the back side of White's die? White does not teach or suggest anything about the desirability of attaching heat spreaders to the top and bottom sides of a die, and Dias only teaches attaching a single heat spreader to the back side of an integrated circuit die. It appears that the Examiner improperly has engaged in hindsight reconstruction of the claimed invention, using applicants' disclosure as a blueprint for piecing together the cited prior art to defeat patentability. Without a proper explanation for combining the cited prior art to arrive at the invention recited in claim 1, the Examiner has failed to establish a proper *prima facie* case of obviousness and the rejection of claim 1 should be withdrawn for this additional reason.

2. Dependent claims 2-9

Each of claims 2-9 incorporates the features of independent claim 1 and therefore is patentable over White and Dias for at least the same reasons explained above. Claims 2-6, 8, and 9 also are patentable over White and Dias for the following additional reasons.

Claim 2 now recites that the electrical signal communication metallization comprises a plurality of exposed bonding elements on the top side of the die. The Examiner has asserted that White discloses the features of claim 2 prior to the present amendment without pointing to any support in White's disclosure. The contact 6 (which the Examiner has stated corresponds to the electrical signal communication metallization recited in claim 1), however, does not comprise a plurality of exposed bonding elements on the top side of White's die. Indeed, the contact 6 is simply a buried tungsten plug that connects the electrical interconnect 9 to the active region 2. Applicant asks the Examiner to point to specific disclosure in White that shows all of the features of claim 2. Otherwise, the rejection of claim 2 over White in view of Dias should be withdrawn.

Claim 3 depends from claim 2 and now recites that the bonding elements are contained in a peripheral region on the top side of the die. The Examiner has asserted that White discloses the features of claim 3 prior to the present amendment without pointing to any support in White's disclosure. Applicant asks the Examiner to point to specific disclosure in White that supports his contention that the contact 6 comprises a plurality of bonding elements that are contained in a peripheral region on the top side of White's die. Otherwise, the rejection of claim 3 over White in view of Dias now should be withdrawn.

Claim 4 depends from claim 3 and now recites that the top side thermal dissipation metallization is contained in a central region on the top side of the die. The Examiner has asserted that White discloses the features of claim 4 prior to the present amendment without pointing to any support in White's disclosure. Applicant asks the Examiner to point to specific disclosure in White that shows all of the features of claim 4. Otherwise, the rejection of claim 4 over White in view of Dias now should be withdrawn.

Claim 5 depends from claim 4 and now recites that the top side thermal dissipation metallization is surrounded by the plurality of bonding elements. The Examiner has asserted that White discloses the features of claim 5 prior to the present amendment without pointing

to any support in White's disclosure. Applicant asks the Examiner to point to specific disclosure in White that shows all of the features of claim 5. Otherwise, the rejection of claim 5 over White in view of Dias now should be withdrawn.

Claim 6 recites that the electrical signal communication metallization surrounds the top side thermal dissipation metallization. The Examiner has asserted that White discloses the features of claim 6 prior to the present amendment without pointing to any support in White's disclosure. Applicant asks the Examiner to point to specific disclosure in White that shows all of the features of claim 6. Otherwise, the rejection of claim 6 over White in view of Dias now should be withdrawn.

Claim 8 recites that the patterned metal layer comprises at least one through-hole. The Examiner has stated that the contact 38, which is disposed over the interconnect 9 shown in FIG. 25, corresponds to the through-hole recited in claim 8. The contact 38, however, clearly is not a through-hole, much less a through-hole of the interconnect 9. It is noted that the contact 38 is formed in a hole in the dielectric layer 36, but the hole in the dielectric layer 36 is not a through-hole of the interconnect 9. For at least this additional reason, the Examiner's rejection of claim 8 under 35 U.S.C. § 103(a) over White in view of Dias should be withdrawn.

Claim 9 depends from claim 8 and recites that the patterned metal layer comprises an array of through-holes. Claim 9 is patentable over White and Dias for the same additional reasons explains above in connection with claim 8.

3. Independent claim 15

Independent claim 15 has been amended and now recites:

> Claim 15 (currently amended): A method of making an integrated circuit system, comprising:
>
> forming on a top side of a substrate multiple die regions each having a top side supporting an exposed electrical signal communication metallization and an exposed top side thermal dissipation metallization;
>
> forming on a bottom side of the substrate an exposed bottom side thermal dissipation metallization for each die region; and

singulating the die regions to form respective integrated circuit dice.

Claim 15 is patentable over White and Dias for at least the same reasons explained above in connection with independent claim 1.

4. Dependent claims 16 and 17

Each of claims 16 and 17 incorporates the features of independent claim 15 and therefore is patentable over White and Dias for at least the same reasons explained above.

B. Claims 10 and 11

The Examiner has rejected claims 10 and 11 under 35 U.S.C. § 103(a) over White in view of Dias and Kunikiyo (U.S. 6,717,267).

In his rejection of claim 10, the Examiner has stated that Kunikiyo "shows a top heat spreader 32 metallurgically bonded (31) to the top side thermal dissipation metallization of the die (dummy pattern 25a)." Kunikiyo, however, does not teach or suggest how the heat sink 32 is attached to the plug 31. Therefore, there is no support for the Examiner's assertion that the heat sink 32 is metallurgically bonded to the plug 31.

For at least these reasons the Examiner's rejection of claim 10 under 35 U.S.C. § 103(a) over White in view of Dias and Kunikiyo should be withdrawn.

It is noted that Kunikiyo only discloses attaching a single heat spreader to an integrated circuit die.

Claim 11 incorporates the features of claim 10 and therefore is patentable over White, Dias, and Kunikiyo for at least the same reasons.

C. Claims 12 and 13

The Examiner has rejected claims 12 and 13 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Wang (U.S. 5,977,626).

Each of claims 12 and 13 incorporates the features of claim 10. Wang does not make-up for the failure of White, Dias, and Kunikiyo to teach or suggest the features discussed

above in connection with claim 10. Indeed, Wang teaches that the heat spreader 32 is attached to the top side of the die 22 using an adhesive, such as a heat spreader attach epoxy (see col. 3, lines 49-53).

For at least these reasons the Examiner's rejection of claims 12 and 13 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Wang should be withdrawn.

It is noted that Wang does not teach or suggest anything about either a top side thermal dissipation metallization or a back side thermal dissipation metallization.

D. Claim 14

The Examiner has rejected claim 14 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Khan (U.S. 6,853,070).

Claim 14 incorporates the features of independent claim 10. Khan does not make-up for the failure of White, Dias, and Kunikiyo to teach or suggest the features discussed above in connection with claim 10. Indeed, Khan clearly teaches that the drop-in heat spreader 202 is attached to the top side of the die 102 using an epoxy 204 (see FIG. 2A and col. 7, lines 29-31). In addition, Khan fails to teach or suggest anything about a top side thermal dissipation metallization.

For at least these reasons the Examiner's rejection of claim 14 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Khan should be withdrawn. The Examiner's rejection of claim 14 also should be withdrawn for the following additional reasons.

Claim 14 recites that the package further comprises a bottom heat spreader metallurgically bonded to the bottom side thermal dissipation metallization of the die. The Examiner has stated that "Khan (e.g., fig. 2A) shows a bottom heat spreader 110 bonded to the bottom side thermal dissipation metallization of the die 102." Khan, however, teaches that the heat spreader 110 is attached to the bottom side of the die 102 using an epoxy (see col. 4, lines 60-61). In addition, contrary to the Examiner's assumption, Khan does not teach or suggest that the die 102 includes a bottom side thermal dissipation metallization.

E. Claim 18

The Examiner has rejected claim 18 under 35 U.S.C. § 103(a) over White in view of Dias and Kunikiyo.

In his rejection of claim 18, the Examiner has stated that Kunikiyo "shows the step of metallurgically bonding a top heat spreader of the package (e.g., 31) to the top side thermal dissipation metallization of the singulated die (dummy pattern 25a)." Kunikiyo, however, does not teach or suggest how the heat sink 32 is attached to the plug 31. Therefore, there is no support for the Examiner's assertion that the heat sink 32 is metallurgically bonded to the plug 31.

For at least these reasons the Examiner's rejection of claim 18 under 35 U.S.C. § 103(a) over White in view of Dias and Kunikiyo should be withdrawn.

As noted above, Kunikiyo only discloses attaching a single heat spreader to an integrated circuit die.

F. Claims 19 and 20

The Examiner has rejected claims 19 and 20 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Wang.

Each of claims 19 and 20 incorporates the features of claim 18. Wang does not make-up for the failure of White, Dias, and Kunikiyo to teach or suggest the features discussed above in connection with independent claim 1. Indeed, Wang teaches that the heat spreader 32 is attached to the top side of the die 22 using an adhesive, such as a heat spreader attach epoxy (see col. 3, lines 49-53).

For at least these reasons the Examiner's rejection of claims 19 and 20 under 35 U.S.C. § 103(a) over White in view of Dias, Kunikiyo, and Wang should be withdrawn.

As noted above, Wang does not teach or suggest anything about either a top side thermal dissipation metallization or a back side thermal dissipation metallization.

III. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

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